CONCENTRATION OF BIOPETROL SYNTHESIZED FROM PALMITIC ACID THROUGH CATALYTIC CRACKING USING GRANULAR METAL AS CATALYST

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ABSTRACT

Biopetrol is defined as fuel which has the same characteristics with commercial petrol in terms of its molecular formula. The objectives of this research are to analyze isooctane obtained from palmitic acid and to improve the concentration of biopetrol obtained from palmitic acid using catalytic cracking. This process is used to produce isooctane from palmitic acid. Heat is supplied using hot plate at palmitic acid's melting point within a range of 63^{o}C – 64^{o}C, to melt the solid palmitic acid. Later, the granular copper is mix with palmitic acid after it turns to liquid. The heating is continuous at isooctane's boiling point of 98^{o}C by using heating mantel 250ml to form new arrangements of carbon compounds including isooctane. The heating is constantly at the same temperature and the samples were collected at the different mass of catalyst which in 20g, 10g, 5g and 1g. The isooctane obtained is around 0.065206%- 0.066561% in palmitic acid with granular copper. After back calculation, the highest concentration of the desired isooctane is 8.379% at 5g copper catalyst with 1% sample + 99% solvent. This research also shows an improvement in concentration of biopetrol (isooctane) compare to the previous research by using thermal cracking.

ABSTRAK

Biopetrol didefinasikan sebagai bahan bakar yang mempunyai formula molekul yang sama dengan petrol biasa. Tujuan penyelidikan ini dijalankan adalah untuk mengenalpasti kepekatan biopetrol (isooktana) di dalam asid palmitik dan memperbaiki kepekatan biopetrol (isooktana) dengan menggunakan kaedah penghuraian pemangkin . Kaedah ini digunakan untuk mendapatkan isooktana daripada asid palmitik. Pepejal asid palmitik dipanaskan pada suhu di antara 63^{o}C – 64^{o}C, iaitu pada takat lebur asid palmitik. Kemudian, ketulan kuprum dicampurkan ke dalam asid palmitik yang telah dicairkan. Proses pemanasan diteruskan sehingga mencapai takat didih isooktana, iaitu 98^{o}C dengan menggunakan 'mantel' pemanas untuk membentuk susunan molekul karbon yang baru. Pemanasan diteruskan pada suhu yang sama dan sekata serta sampel diambil pada jisim mangkin yang berlainan dalam 20g, 10g, 5g dan 1g. Kepekatan isooktana yang diperolehi di dalam didihan asid palmitik dan ketulan kuprum adalah dalam lingkungan 0.065206%- 0.066561%. Selepas mengira semula kepekatan isooktana dengan pencairan heksana, kepekatan tertinggi adalah pada jisim 5g dengan 1% sampel + 99% pencair iaitu sebanyak 8.379%. Penyelidikan ini juga telah menunjukkan peningkatan dalam kepekatan biopetrol (isooktana) berbanding dengan penyelidikkan yang telah dijalankan sebelum ini dengan menggunakan penghuraian pemanasan.

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LIST OF ABBREVIATIONS

P	-	Pressure
m	-	Mass
ΔH	-	Enthalpy change of reaction
ΔS	-	Entropy change of reaction
ΔG	-	Energy change of reaction
T	-	Temperature
ρ	-	Density
μ	-	Viscosity of liquid (Pa.s)
h	-	Heat transfer coefficient
^{o}C	-	Degree Celsius
kg	-	Kilogram
K	-	Degree Kelvin
m	-	Meter
n	-	Number of moles
L	-	Liter

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CHAPTER 1

INTRODUCTION

1.0 Introduction

As in other Asian countries, price rises are hitting Malaysia, raising concerns in ruling circles over the potential for social discontent and protests. Inflation, particularly for fuel, was a major issue in this year. The amounts of fuels reserve in this world are decreasing and since than, the prices of fuel are increasing gradually every year. Many researches have been conducted to find other alternative fuel to substitute petrol which is now found biopetrol as a new fuel. Biopetrol is defined as fuel which has the same characteristics with commercial petrol in terms of its molecular formula. Many researchers have developed a process based on palm oil and convert it to biofuels. Biopetrol is suitable for petrol engine. This study is to find the concentration of isooctane from palmitic acid in palm oil waste.

1.1 Research Background and Problem Statement

Petroleum price is increasing dramatically every year and it will burden people especially to the lower working class. This crisis happen because of the decreasing fuel supply and the sources are unevenly spread. Most petroleum reserves are in the Middle East or West Asia, causing economic and political instabilities. Producing petrol from the waste of palm oil (palmitic acid) will give an alternative choice to the users, especially for petrol-engine vehicles' owners. In addition, this biopetrol, which is graded 100 for its octane number, burns very smoothly so biopetrol can reduce emissions of

some pollutants (Omar, 2005:3). Figure 1.1 shows the Malaysia's Oil Production and Consumption for 1990 until 2008.

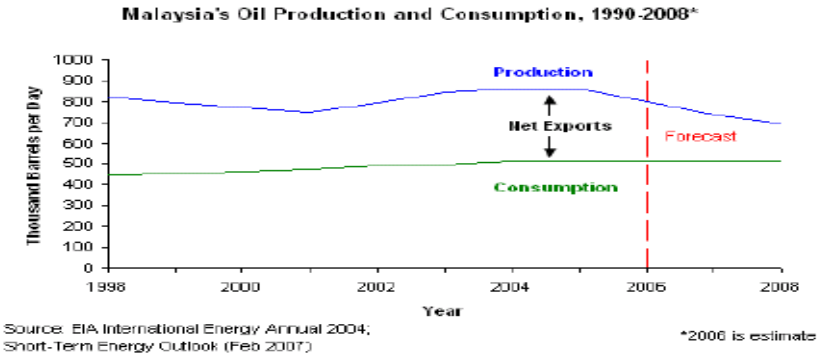

Figure 1.1: Malaysia's Oil Production and Consumption

From figure 1.1, the blue line represents the production of oil which is 820,000 barrels per day in 1998 and decreasing to 620,000 barrels per day in 2008. Within 10 years from now, all of crude oils will finish up without any preservation awareness. Figure 1.2 shows the fuel price in Malaysia from May 2004 to Jun 2008.

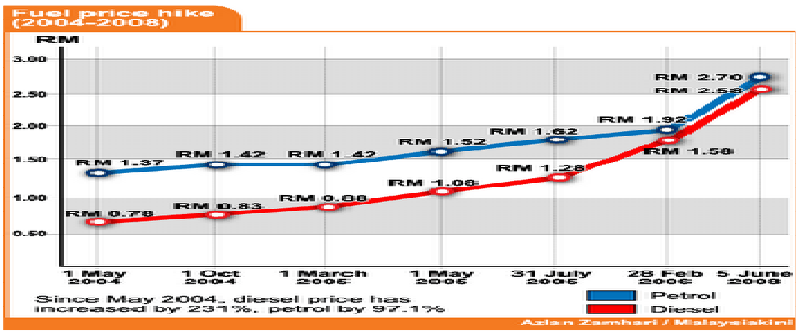

Figure 1.2: Fuel price in Malaysia from May 2004 to Jun 2008

From figure 1.2, the blue line represents the fuel price for petrol which is RM 1.37 in May 2004 and increasing gradually to RM 2.70 in June 2008. Therefore, the increasing of fuel price will contribute to the decreasing of oil production and the increasing of inflation.

Palmitic acid is the dominative component in palm oil waste. Its disposal into water supply sources causes serious water pollution. Besides that the loss of palmitic acid as a useful industrial component also occurs so that it is not utilized much and always eliminated to improve and upgrade the quality of crude palm oil. Thus, it is disposed as palm oil waste and then pollutes water resources by its spillage.

According to the previous research, the yield of biopetrol using thermal cracking is very small. In this research, the concentration of isooctane that is produced from palmitic acid and also the conversion of fatty acids to form desired isooctane in biopetrol will be improved by using catalytic cracking process and use copper granular as catalyst.

1.2 Objectives

i. To analyze isooctane obtained from palmitic acid.
ii. To improve the concentration of biopetrol obtained from palmitic acid using catalytic cracking.

1.3 Scopes

i. To describe the molecular arrangement of isomerization in catalytic cracking process with presence of catalyst.
ii. To apply the catalytic cracking process instead of previous thermal cracking.
iii. To determine the amount of isooctane after catalytic cracking.
iv. To identify the composition of isooctane using Gas Chromatography method.

1.4 Rationale and Significance

Biofuels are very popular in market demand nowadays for instance biodiesel, biopetrol and biomass. There are many advantages of biofuel which are:

i. Environmental friendly for palmitic acid.
ii. Contribute to the society in preventing the community from any harm and danger for instance water and air pollutions.
iii. Producing more biopetrol and commercialize it with reasonable price.
iv. Inexpensive expenditure for copper and palmitic acid.
v. Biofuels are biodegradable.

CHAPTER 2

LITERATURE REVIEW

2.0 Definition of fuel

Fuel (from Old French ***feuaile***, from ***feu fire***, ultimately from Latin focus fireplace, hearth) is a material that can be burned or otherwise consumed to produce heat. The common fuels used in industry, transportation, and the home are burned in air. The carbon and hydrogen in fuel rapidly combine with oxygen in the air in an exothermal reaction one that liberates heat. Most of the fuels used by industrialized nations are in the form of incompletely oxidized and decayed animal and vegetable materials, or fossil fuels, specifically coal, peat, lignite, petroleum, and natural gas. From these natural fuels other artificial ones can be derived. Gasoline, kerosene, and fuel oil are made from petroleum. For most transportation, fuel must be in a liquid form.

2.1 Fuel Types by Period of Natural Renovation

2.1.1 Fossil Fuels

Fossil fuels or mineral fuels are fossil source fuels, that is, hydrocarbons found within the top layer of the Earth's crust. They range from volatile materials with low carbon:hydrogen ratios like methane, to liquid petroleum to nonvolatile materials composed of almost pure carbon, like anthracite coal. Methane can be found in hydrocarbon fields, alone, associated with oil, or in the form of methane clathrates. It was estimated by the Energy Information Administration that in 2005, 86% of primary

energy production in the world came from burning fossil fuels, with the remaining non-fossil sources being from hydroelectric 6.3%, nuclear 6.0%, and others (geothermal, solar, wind, and wood and waste) 0.9%.

Fossil fuels are non-renewable resources because they take millions of years to form, and reserves are being depleted much faster than new ones are being formed. The production and use of fossil fuels raise environmental concerns. A global movement toward the generation of renewable energy is therefore under way to help meet increased energy needs.

The burning of fossil fuels produces around 21.3 billion tonnes (= 21.3 gigatons) of carbon dioxide per year, but it is estimated that natural processes can only absorb about half of that amount, so there is a net increase of 10.65 billion tonnes of atmospheric carbon dioxide per year (one tonne of atmospheric carbon is equivalent to 44/12 or 3.7 tonnes of carbon dioxide). Carbon dioxide is one of the greenhouse gases that enhances radiative forcing and contributes to global warming, causing the average surface temperature of the Earth to rise in response, which climate scientists agree will cause major adverse effects, including reduced biodiversity and, over time, cause sea level rise. Figure 2.1 shows the global fossil carbon emission by fuel type in 1800 until 2004 AD.

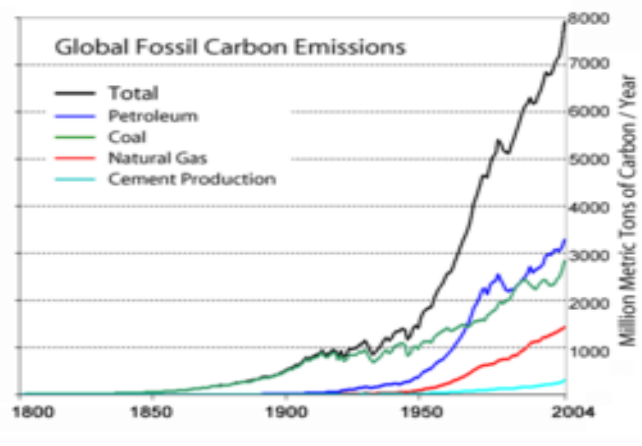

Figure 2.1: Global fossil carbon emission by fuel type, 1800-2004 AD.

The principle of supply and demand suggests that as hydrocarbon supplies diminish, prices will rise. Therefore higher prices will lead to increased alternative, renewable energy supplies as previously uneconomic sources become sufficiently economical to exploit. Artificial gasoline and other renewable energy sources currently require more expensive production and processing technologies than conventional petroleum reserves, but may become economically viable in the near future. See Energy development. Different alternative sources of energy include nuclear, hydroelectric, solar, wind, and geothermal (Dr. Irene Novaczek, 2007).

2.1.2 Biofuel

Biofuel can be broadly defined as solid, liquid, or gas fuel derived from recently dead material. This distinguishes it from fossil fuels, which are derived from long dead biological material. Biofuel can be theoretically produced from any (biological) carbon source, though the most common by far is photosynthetic plants. Many different plants and plant-derived materials are used for biofuel manufacture. Biofuels are used globally, most commonly to power vehicles and cooking stoves. Biofuel industries are expanding in Europe, Asia and the United States.

Biofuels offer the possibility of producing energy without a net increase of carbon into the atmosphere because the plants used in to produce the fuel have removed CO_2 from the atmosphere, unlike fossil fuels which return carbon which was stored beneath the surface for millions of years into the air. Biofuel is therefore more nearly carbon neutral and less likely increase atmospheric concentrations of greenhouse gases (though doubts have been raised as to whether this benefit can be achieved in practice, see below). The use of biofuels also reduces dependence on petroleum and enhances energy security.

There are two common strategies of producing biofuels. One is to grow crops high in either sugar (sugar cane, sugar beet, and sweet sorghum) or starch (corn/maize), and then use yeast fermentation to produce ethyl alcohol (ethanol). The second is to grow plants that contain high amounts of vegetable oil, such as oil palm, soybean, algae, or jatropha. When these oils are heated, their viscosity is reduced, and they can be burned directly in a diesel engine, or the oils can be chemically processed to produce fuels such as biodiesel. Wood and its byproducts can also be converted into biofuels such as woodgas, methanol or ethanol fuel. It is also possible to make cellulosic ethanol from non-edible plant parts, but this can be difficult to accomplish economically.

2.1.3 Biodiesel

Biodiesel is a clean burning liquid fuel produced from domestic, renewable resources like soybeans, peanuts and even recycled cooking oils or animal fats. Biodiesel refers to a non-petroleum-based diesel fuel consisting of short chain alkyl (methyl or ethyl) esters, made by transesterification of vegetable oil, which can be used (alone, or blended with conventional petrodiesel) in unmodified diesel-engine vehicles. Biodiesel is distinguished from the straight vegetable oil (SVO) (sometimes referred to as "waste vegetable oil", (WVO), "used vegetable oil", (UVO), "pure plant oil", (PPO)) used (alone, or blended) as fuels in some converted diesel vehicles. "Biodiesel" is standardized as mono-alkyl ester and other kinds of diesel-grade fuels of biological origin are not included.

Biodiesel is simple to use, biodegradable, non-toxic, and essentially free of sulfur and aromatics. Biodiesel reduces serious air pollutants such as particulates, carbon monoxide, hydrocarbons, and other air toxins. Biodiesel can be made simply and has been for over a hundred years. Biodiesel can be used as a cleaner-burning vehicle fuel and a source for residential or commercial heating. Figure 2.2 shows the space-filling model of methyl linoleate and Figure 2.3 shows the space-filling model of ethyl stearate.